Summer 1996

Center for Grassland Studies Newsletter, Summer 1996, Volume 2, No. 3

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From the Director

There has been much interest and dialogue about the environment and its preservation in recent years. Grasses growing in all locations and for different purposeswhether it be for turf, forage, or landscape purposes, or in areas designated as cropland, rangeland, wetlands, or other natural habitatsare among the best plants for environmental sustainability.

Grasses affect the lives of every living person either by the protection provided the environment, the food they produce directly or indirectly, and/or the recreational and aesthetic benefits. Grasses have fibrous root systems and grow in dense swards, which make them especially effective in preventing both wind and water erosion in urban as well as rural areas. Grasses increase soil organic matter and recycle nutrients from different sources. These plants conserve our water and soil resources by serving as living filters for purifying surface and ground water and reducing soil erosion. They purify the air by extracting carbon dioxide used in photosynthesis and releasing oxygen in the process. They also improve the quality of life by providing aesthetically pleasing landscapes. Thus, they serve as a natural basis for sustaining a high quality environment.

Grasslands, rangelands, and wetlands cover more than half of the land area in this country, and are found in all states. Henry Wallace, a former Secretary of Agriculture, wrote in 1940 that grass is a source of strength for agriculture, and therefore, to the nation. He stated, "The more we fail to realize this, the more difficult it will be to maintain and build up our great agricultural resources, our soil resources, and yes, our human resources too."

In this regard, the Center for Grassland Studies and several of its Associates have been working cooperatively with a number of organizations, but in particular with Landscapes Unlimited, Inc. (which is CGS Citizens Advisory Council member William Kubly's company), and the National Arbor Day Foundation, in an effort to organize a program to address a number of issues facing golf and the environment today. Additional partners include the United States Golf Association, the Golf Course Superintendents Association, the American Society of Golf Course Architects, and other industry members. The Palmer-Seay Design Company will work with Golfscapes to co-design a living classroom golf course at Arbor Day Farm in Nebraska City, Nebraska. The primary purpose of this program is to conduct the research and educational programs underlying the principles established by both the golf and environmental communities. We believe it is the kind of program that will enable both the golf and environmental communities to be mutually supportive of each other. Yes indeed, this is an exciting new project!

Matching the Cow with Forage Resources(1)

By Don Adams, Richard Clark, Terry Klopfenstein, and Jerry Volesky
Agricultural Research Division, UNL

Profitability of beef production depends on quantity of beef produced, prices received, and production costs. Producers generally have more control over the quantity of beef produced and costs than prices received. Reducing production costs while maintaining output levels will reduce costs per unit of output.

The concept of matching nutrients available in forages with nutrient requirements of the cow has been recommended as a means to most efficiently utilize grazed forages (Valentine 1990, Vavra and Raleigh 1976). They identified complementary forages, calving date, and weaning date as resources for matching forages with the nutrient needs of the cow. We further develop concepts to improve the match between forage quality and the cow's nutrient needs and discuss potential impacts on management, production cost, and profitability.

Background

While grazing lands are the base resource and investment, harvested forages, grain, and supplements made up 35-40% of total variable, cash costs in North Central, Great Plains, and western cow-calf operations in 1992 and 1993 (Economic Research Service 1995). Adams et al. (1994b) reported that extending the grazing season in early spring and/or more winter grazing increased returns per cow about $50 to $90. When the cow and range resource are well matched, the cow should receive most nutrients from grazed forages. Extending grazing and/or matching the cow to the range forage will likely result in lower production costs and greater net returns.

Two general factors determine how well the animal and range resource match: 1) genetic potential for milk production in the cow, and 2) synchrony between the animal's requirement during lactation and the highest nutrient value in the forage. When nutrient requirements for the animal are matched with nutrient output of forages, purchased feeds and labor can be reduced without reducing animal productivity.

Compared to cows in moderate body condition, thin cows or cows in low body condition at calving are more likely to breed late in a breeding season or not breed at all, which reduces the net calf crop (i.e., number of calves weaned per cow exposed to the bull; Dziuk and Bellows 1983). The pounds of beef produced declines with a declining net calf crop. To be profitable, a grazing-based system must maintain a moderately high net calf crop.

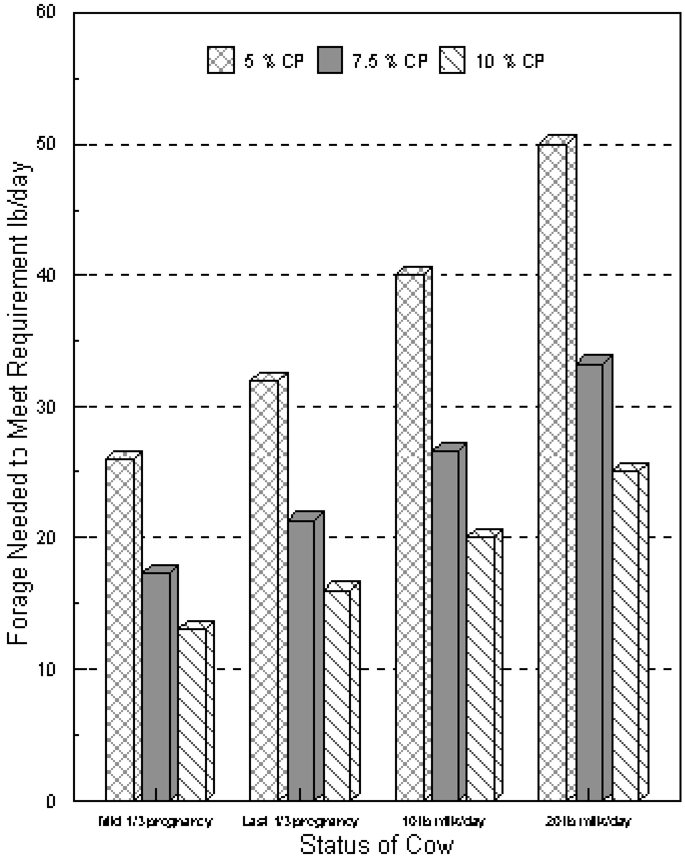
Cyclical nature of plant nutrient density

The quantity and quality of forage produced on rangelands are highly cyclical, within and between years. Precipitation, plant species, and the proportion of cool and warm season species affect the overall forage quality of rangeland at any point in time. Seasonal changes in nutrient density of rangeland forage are primarily associated with plant maturity. Plants contain their greatest nutrient value before maturity. In general, diets from dormant range contain between 4 and 7% crude protein with higher concentrations occurring in late summer and early fall and lower concentrations occurring during late fall and winter. Plants in a vegetative state generally contain over 10% crude protein (Adams and Short 1988).

Nutrient requirements of the cow

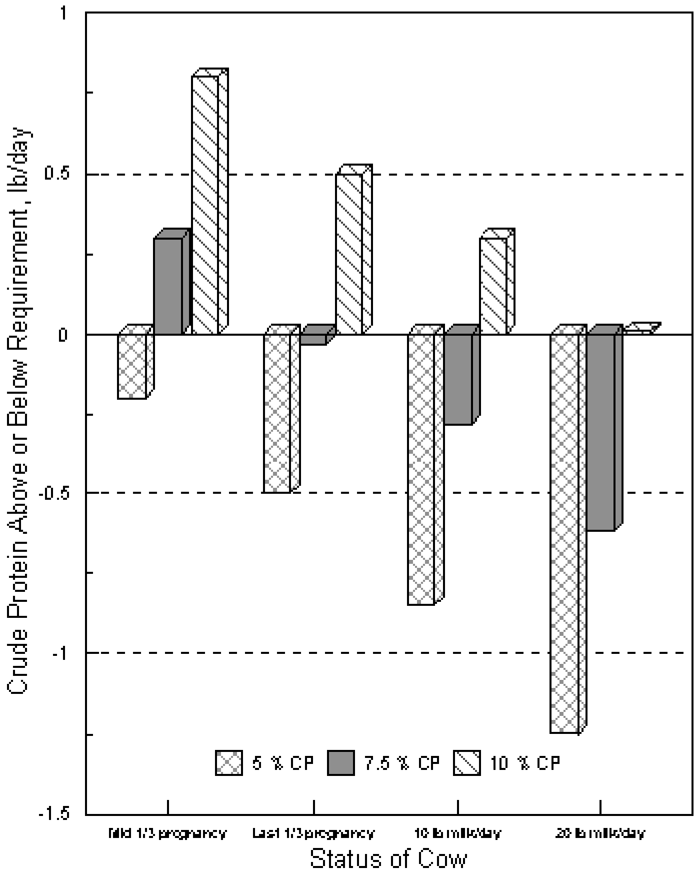
Cow size, milk production, pregnancy, and activity are the primary influences on nutrient needs of cattle. The larger the cow, the more energy and protein required for maintenance. The total digestible nutrient (TDN) and crude protein requirements during the last third of pregnancy are about 20 and 14% greater than during the middle third of pregnancy, respectively. Cow protein and energy requirements are greater during lactation than any other time of the 12-month production cycle, and requirements increase with increasing milk production.

Figure 1 demonstrates the relationship between the density of crude protein in a forage and the amount of forage needed to meet the crude protein requirements of a 1000 lb cow during mid- and late pregnancy and at 2 levels of milk production. As requirements for pregnancy and lactation increase, the amount of forage needed increases at all densities of crude protein. The greatest amount of forage needed is for a cow producing a high level of milk.



Plant-animal interactions

The fibrous, bulky nature of forage and low concentration of crude protein limit the amount of forage an animal consumes. Inability of an animal to consume enough nutrients in a forage diet is greatest when density of the nutrient is low and/or when animal requirements are high. Figure 2 shows the relationship between crude protein density in the forage and the ability of a 1000 lb cow to consume adequate forage to meet crude protein requirements. A cow grazing a forage containing 5% crude protein is not likely to consume enough forage to meet protein requirements at any phase of the production cycle. A forage containing 5% crude protein is common in late fall and winter range. Dormant fall-winter range will likely not support milk production and maintain cow body weight and body condition without supplementation (Adams et al. 1994a, Short et al. 1994). Cows would likely consume enough forage to meet requirements at all production phases when the forage contains 10% or greater concentration of crude protein.

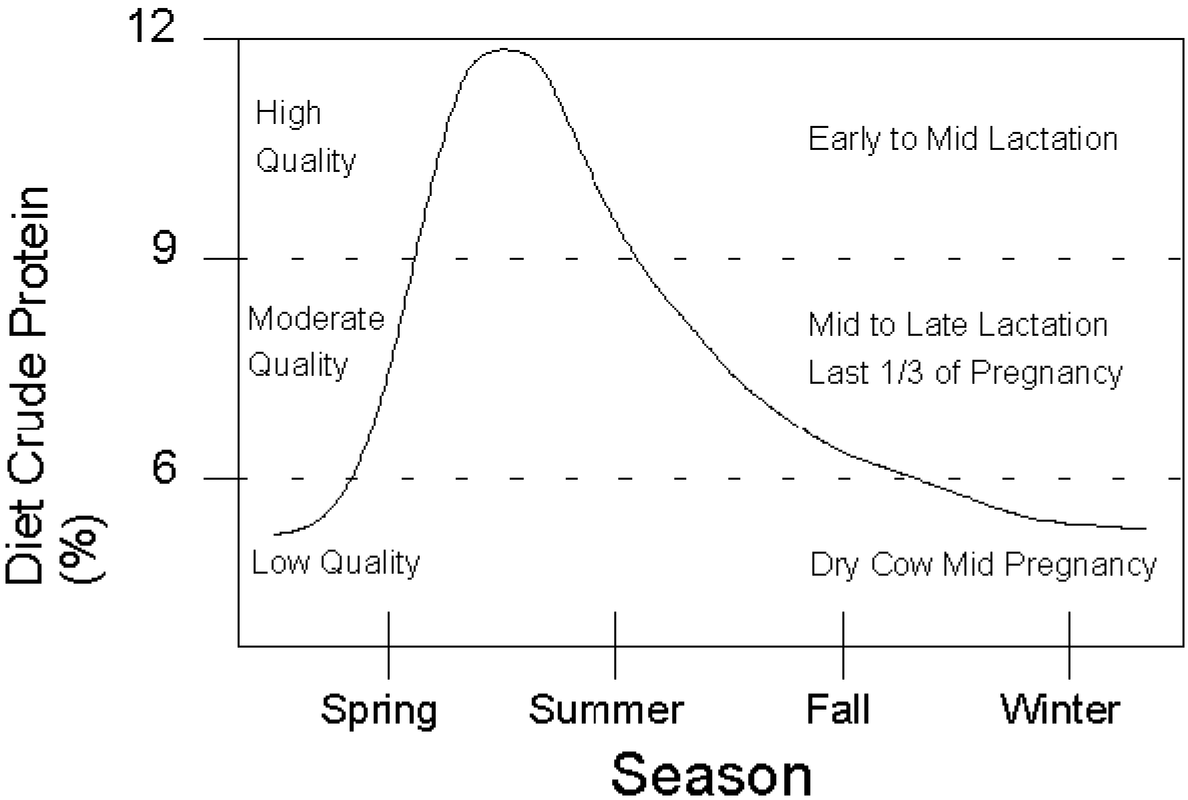


Cows consuming a forage containing 55% or more total digestible nutrients would meet requirements for all stages of the production cycle and up to 20 pounds of milk production. Many studies report digestibility values for range forage of over 50% during most of the year. Digestibility values below 50% for range forage are reported for cold winter conditions. A cow would not be able to consume enough of a forage containing 45% total digestible nutrients to meet requirements of the last third of pregnancy or milk production. Protein may be limiting before energy in many western range diets.

Matching the cow to range forage

The mismatch between nutrient density and cow requirements may result from several situations related to lactation. First, high requirements (i.e., late pregnancy and lactation) for cows calving in late winter or early spring occur before green grass when grazed forages have low concentrations of protein and energy. The problem is exacerbated by high milk production and usually mitigated by feeding of hay or supplements. Second, the amount of milk a cow produces may exceed that which the forage will support at certain times of the year. Third, late fall weaning results in cow requirements greater than low protein forages can support, even at a low level of milk production.

We suggest that the cow is matched best with the range forage when peak lactation occurs near the highest density of protein in the forage and when milk production potential in the cow herd is moderate and weaning occurs before significant amounts of body condition are lost. Conversely, low requirement stages (e.g., dry cow) are matched with low nutrient density in the forage. Figure 3 illustrates the seasonal forage quality changes and cow status association.



Lactation and pregnancy are more critical in matching the cow to the forage resource than body size because of the need for greater nutrient density in the forage. Increased requirements for cow size do not require greater nutrient density because large cows have increased capacity to eat. However, both cow size and amount of milk produced affect stocking rate. Increasing either body size or milk production increases the amount of forage needed to sustain the cow.

Winter weather can result in a nutrition imbalance for cattle grazing on range. Intake and digestibility of range forage may be lower during cold weather. A high energy requirement because of cold and low forage intake generally results in loss of body condition. The coldness and length of cold weather determine impacts on the cow. Snow presents a nutritional limitation when it is deep or when it thaws and freezes creating a crust, thus limiting access to forage.

In a spring calving system, body condition of the cow at the beginning of the winter grazing period is important. There is evidence that with or without supplemental feeding cows cannot gain body condition during winter grazing (Sanson et al. 1990, Villalobos et al. 1993).

Adjusting forage to match the cow

Seeded cool or warm season forages can fill a void in the natural production systems. Grasses such as crested wheatgrass and Russian wildrye have potential to provide green forage up to 3 weeks earlier in the spring than native range.

Coady and Clark (1993) found that producers in Nebraska's Sandhills seldom graze cattle on meadows in the spring despite the fact that meadows are dominated by cool season species and would offer a relatively high quality forage sooner than uplands. The general spring management practice is to feed hay, which is expensive.

Other opportunities for extending grazing with complementary grazing include crop residues such as corn and sorghum stalks for fall and winter. If grazing is managed properly, stalks provide a relatively high quality diet. Crop residues are not always located adjacent to range or pasture but even with trucking costs, residues may be an economical way to extend grazing and reduce feed costs.

When standing range or pasture forages will not meet cow requirements, harvested forages, grains, and protein concentrates are fed as either supplements or the full diet. Supplements with grazed forages are likely to have lower costs and greater net returns than feeding a full diet. Generally, protein supplements have been more effective for utilizing low quality forages than energy from grain supplements. Protein supplements have maintained body condition of cows nursing calves on dormant forages in the fall (Short et al. 1994), and dry cows during winter on range (Villalobos et al. 1993). Grain supplements have not maintained body weight of cows grazing winter range (Sanson et al. 1990). The first limiting nutrient is rumen degradable protein. Grain supplies energy for both the rumen microorganisms and the cow, but exacerbates the degradable protein deficiency. If sufficient rumen degradable protein is supplied, then grain is an effective source of energy.

Adjustments in date of harvest of forages can help reduce costs for systems requiring hay. Harvesting forages when plants are immature increases the concentration of crude protein (Reece et al. 1994). Hays with higher density of crude protein can be fed when nutrient requirements are high and reduce the need for supplements. Additionally, high protein grass or legume hay can be fed as a protein supplement for cows grazing low quality forages. Harvesting younger forage for high protein often sacrifices yield. Therefore, portions of hay acreage could be harvested at later dates for higher yield and that lower quality hay can be used for maintenance when cow nutrient requirements are lowest.

Adjusting the cow to match the forage

The amount of harvested and purchased feeds required to sustain a cow herd is highly correlated with dates of calving and weaning. Researchers and others have long been aware of these facts, but the majority of research has been directed towards adjusting the forage system to meet animal requirements and maximizing animal production rather than adjusting livestock reproduction cycles to meet the forage resource.

Seventy-five percent of Sandhill producers surveyed calved cows before 10 March (Clark and Coady, 1992). This matches the highest nutrient requirements of cows with the lowest nutrient value of forages. Thus, significant inputs of harvested and processed feeds are required to ensure that a high percentage of the cows rebreed and produce a calf the following year. Furthermore, fewer producers are utilizing forages for growing calves after weaning due to calf size at weaning and market timing.

Changing calving date is an alternative approach for matching nutrient requirements of cattle with nutrient content of natural forages. The concept of adjusting calving date is to synchronize calving season with growth of range and/or pasture. Calving might begin from 2 weeks before to a month after the range is growing. If range is ready for grazing in early May then calving season might begin from late April to early June. Calving then would match the highest nutrient requirements of the cow with the highest nutrient density of range and pasture forage. We estimate that 2,000 pounds of harvested forage can be saved per cow each year with summer (June) versus early spring (February-March) calving on ranches in Nebraska's Sandhills and other Northern and Central Great Plains states. Changing the calving date may also offer more opportunities to grow calves on a forage diet by over-wintering and grazing yearlings on range the next year (Klopfenstein 1991). Changing the calving date affects the entire ranch operation. The profitability of such a change depends on the effects on production levels, marketing, and total input needs, including labor. Peak labor demands will shift and could interfere with labor needs in other parts of the operation. Overall profitability may depend on date of weaning and whether or not ownership is retained on calves through their life cycle.

Marketing strategies will change if calving season is changed more than a few weeks. For example, feeder steer prices in western Nebraska and eastern Wyoming tend to peak February to April. Producers who calve later may be able to take advantage of that seasonal price trend. On the other hand, slaughter steer prices tend to be lowest late July to September. Calves from summer calving that are grown for a short period and finished could hit the seasonal low price period for fed cattle.

Adjusting weaning dates is another alternative to reduce nutrient requirements for cows. Weaning calves will remove the nutrient need for lactation and may be helpful when nutrient density of available forages is low.

Economic benefit from extending grazing

A study compared winter and spring grazing and hay feeding systems (Adams et al. 1994b). The most profitable and least risky systems involved winter grazing on range or subirrigated meadow and grazing subirrigated meadow in May. May grazing of meadows places spring calving, lactating cows on green grass earlier than is possible on upland range when their nutritional requirements are high, thus reducing the need to feed hay and supplemental protein. The least profitable and most risky system included hay in both winter and May. Forage and feeding costs made hay feeding systems lower in profitability and higher in risk. The most profitable systems took advantage of matching cow nutritional requirements with the nutritional value of the native grasses.

Conclusions

Reducing the need for feeding hay can improve profitability of a cow/calf operation. Grazing complementary forages and grazing during the winter are two systems that seem to work. If a ranch does not have complementary forages or range for winter grazing, crop residues may improve profitability over feeding harvested forages. Changing calving and weaning dates appear to hold promise as methods to synchronize the cow's nutrient needs with grazed forages. Producers, however, must realize that cow size and milk production potential are important determinants of overall nutrient needs. High milk production may create nutrient imbalance in a more subtle manner when nutrient density of forage is low and cows cannot consume adequate volume to meet nutrient needs.

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(1)Reprinted with permission from *Rangelands* magazine, April 1996, published by the Society for Range Management. For a list of references cited, contact the CGS. Adams and Klopfenstein (Animal Science), Clark (Ag. Economics) and Volesky (Agronomy) are Associates of the CGS.

Grassland Biodiversity, Large Grazers and Fire

By Al Steuter, The Nature Conservancy

The role of biological diversity in maintaining ecosystem health is similar to the role of enterprise diversity in maintaining economic health. Indeed, ecosystems and economies can be viewed as integrated components of larger regional systems. By understanding the evolutionary history of grassland resources we should be better able to conserve them as a hedge against an unpredictable future. The Nature Conservancy began managing and doing research on Great Plains grasslands, bison and fire on the Samuel H. Ordway, Jr. Memorial Prairie in South Dakota during the late 1970s. Similar efforts are now underway at the Niobrara Valley Preserve in Nebraska, Tallgrass Prairie Preserve in Oklahoma, Konza Prairie in Kansas, and Cross Ranch Preserve in North Dakota. Scientists associated with the Center for Grassland Studies and other universities, colleges and agencies contribute to this effort. Our goal is to learn how to maintain biological diversity in a new and ever-changing landscapenot to return the Great Plains to a pre-European, pre-human, or other previous condition.

On the native grasslands of the world, it is a rare event for the herbaceous regrowth to go ungrazed following a fire. Consequently, the pattern and amount of forage removed from a site determines the probability and intensity of the next fire event. This interaction between fire and grazing yields the dynamic habitat mosaic to which invertebrates, mammals and birds are adapted. Yet, ecological research has traditionally dealt with fire and grazing as unique treatments, applying them to discrete study plots selected for their homogeneity and controlled for all other variables. We used historical accounts and published results of controlled experimentation to develop a conceptual model of how the large-scale interaction between bison and fire may have affected the distribution and abundance of Great Plains species and habitats. The model summarized what we "knew" about the bison-fire interaction and suggested the initial bison stocking rates and fire regimes for our bio-regional experiment.

Our study areas represent northern mixed prairie, sandhills mixed prairie, Flint Hills tallgrass prairie, and Osage Hills tallgrass prairie spanning 11 degrees of latitude. Bison herds are confined within large heterogeneous landscape units. On three study areas, dormant season and growing season prescribed burns are applied based on the location of high fuel loads rather than a predetermined experimental design. The total acreage burned in a given year is based on the average pre-European fire regime for that study area. However, an individual patch within a study area develops a unique fire history based on its fuel accumulation dynamics. On the fourth study site, Konza Prairie, bison have access to watershed scale replicates of several fire frequency-season combinations within a fixed randomized block design. We are comparing: 1) the pattern of soil nitrogen distribution to plant species distributions; 2) the patterns of plant, invertebrate, pocket gopher, bird, and bison distribution; and 3) vegetation patterns sampled by surface quadrats, to high level aerial imagery and satellite imagery at 30 m and 1 km scales. We are also comparing these bison grazed to cattle grazed landscapes.

Our preliminary results suggest an interesting parallel between the distribution of forbs and pocket gophers, and grasses and bison based on resource capture strategies. Both forbs and pocket gophers appear adapted to capturing resources (nitrogen and forbs, respectively) from small concentrated patches within a low quality matrix. In contrast, grasses and bison appear adapted to utilizing resources (nitrogen and grass, respectively) from the low quality matrix. Because of the increased forage (grass) quality following fire, our model predicted that burned sites would be intensely used by bison during the next growing season. We did not predict differences in this interaction based on topography.

Bison respond to fire as predicted when the landscape is open and gently rolling-to-level. However, there is only a weak attraction to burns in wooded or hilly topography. As with other large ungulates, group size in bison is directly related to the openness of their habitat. This relationship is enhanced by the gregarious breeding behavior of bison. Thus, the bison breeding season corresponds with the peak growth period for grasses. Bison congregate into large herds at this time of year and prefer open expanses of grassland even when more nutritious forages are available in recently burned, but hilly or wooded areas. At the landscape scale, this results in relatively slow fuel accumulation on gently rolling, and more rapid fuel accumulation in rough or wooded areas. Fire frequency might therefore be higher than expected in rough or wooded areas and lower than expected on open grasslands. The opposite would be expected based on the relationship between fire behavior and topography.

On recent burned patches, bison intensively and selectively graze grasses, especially bunch grasses, and avoid forbs. This results in a shift in plant biomass favoring rhizomatous grasses and/or forbs, depending on whether it was a spring or summer fire, respectively. Bison selection for a burned area declines with time, and as it does, plant composition again shifts. Plant community composition and diversity at the landscape scale will be a product of these complex spatial and temporal mosaics. The distribution and abundance of invertebrates, small mammals and birds is affected by species specific needs for habitat.

Hopefully, our research will provide information to address questions such as: How large a landscape is required to play out herbivore-fire interactions in a way which is beneficial for the array of Great Plains species? How do the landscape mosaic and species distributions compare on lands managed with cattle versus bison? How can grazing and fire management be applied to fragmented grasslands to encourage species diversity?

Info Tufts

Congratulations to CGS Citizens Advisory Council member William Kubley, President of Landscapes Unlimited, who received the Dr. Herbert H. Davis Memorial Award at the Nebraska Golf Hall of Fame Annual Awards Banquet in May.

The June 1996 issue of *The Stockman Grass Farmer* carried an article titled "High Stock Density Grazing Improves Nebraska Pastures," which mentioned CGS Citizens Advisory Council member, Rob Ravenscroft, as one of the ranchers using management-intensive grazing to improve Nebraska pastures.

Deadlines have been announced for the next round of funding for the USDA National Research Initiative Competitive Grants Program. Of particular interest to CGS Associates are the categories of Forest/Range/Crop/Aquatic Ecosystems (Nov. 15) and Agricultural Systems (Feb. 15). More information is available at the URL

http://www.reeusda.gov/new/nri/nricgp.htm.

American Forage and Grassland Council Conference

By Lowell Moser, Department of Agronomy, UNL

Vancouver, British Columbia, was the site of this year's American Forage and Grassland Council conference June 13-15. Presented papers emphasized forage production, quality, utilization, and economics. Participants toured the Fraser Valley, visiting dairy farms and Agriculture and Agri-Food Canada's Agassiz Research Station. The tour emphasized forage production, grass-based dairy systems, corn silage production practices, and manure disposal. Nutrient disposal is a major concern in the Fraser Valley since there is limited land area to dispose of the waste from intensive dairy, poultry, and swine operations. Participants also learned about the magnitude and economic significance of forage exports from the U.S. and Canadian Pacific Northwest to Japan and other Pacific Rim markets. This includes alfalfa cubes, alfalfa pellets, and both alfalfa and grass baled hay. For example, the state of Washington had total forage exports exceeding $105 million in 1995.

At the meeting Nebraska's Paul Meyer, commercial alfalfa hay producer at West Point, was installed as the AFGC President for 1996-97. Paul's year will culminate with the 1997 AFGC conference in Fort Worth in April. After the 1998 conference in Indianapolis, the AFGC will hold a joint meeting with the Society for Range Management in Omaha in February, 1999.

CGS Citizens Advisory Council Holds Third Meeting In Western Nebraska

The weather was made-to-order for the June 28 meeting that included a tour of the Gudmundsen Sandhills Lab (GSL) near Whitman in the morning and a visit to the natural setting Sand Hills Golf Club near Mullen in the afternoon. About 40 Citizens Advisory Council members and CGS Associates participated in the day's activities.

At the GSL Don Adams, Dick Clark, Jim Goeke and Jerry Volesky talked about production and economics of cattle grazing, hydrology and geology of the sandhills, and meadow forage research and management. Back at the GSL conference center Marian Borgmann-Ingwersen gave a presentation on fens and restoration efforts underway by The Nature Conservancy. Tony Joern spoke about the impact of grasshoppers on forage production, pointing out that there are about 100 species of grasshoppers in the sandhills, only 5-6 of which are of consequence for forage production.

Co-owner and developer Dick Youngscap told us the Sand Hills Golf Club was modeled after a course in Scotland. "The objective was not to *build* a course, but to *find* one," he said. Very little earth was moved to create the course. The fairways are a blend of 4-5 fescues. Dick said the skill that golfers will develop the most is learning how to hit the ball low because of the windy conditions so common in western Nebraska. Bob Shearman spoke about native grasses, saying that buffalo and gamma grasses are the only U.S. native grasses that are adaptive for turf.

CGS Associate News

Ann Antlfinger is co-author of a recently published paper based on work at Nine-Mile Prairie in southeast Nebraska, "Characteristics of leaf photosynthesis in *Spiranthes cernua*: A field study." *Spiranthes* is one of the few terrestrial orchid species at Nine-Mile. Contact the CGS for a copy of the paper.

Nebraska Grazing Lands Coalition Formed

As a result of a national voluntary effort to enhance private grazing lands, the Nebraska Grazing Lands Coalition has been formed. It is made up of producers representing different regions of the state and several producer groups. At its first meeting on June 29 in Kearney, the Coalition outlined several areas of concern, worked on a draft plan of operations, decided to become non-profit, discussed the publication of information and education items, and planned the next meeting which will be August 27 at the Cooksley Ranch in Anselmo. Jacque Matthews and Walter Fick were elected co-chairs. For more information contact Jacque at 308-587-2491.

Contact CGS for more information on these upcoming events:

CALENDAR

Aug. 19-20/21-22	Integrated Resource Management Conference, North Platte/O'Neill, NE
Aug. 20-24	7th International Grouse Symposium, Fort Collins, CO
Aug. 22	Nebraska Society for Range Management summer tour, Halsey, NE
Sep. 12-13	Native Warm Season Grass Conference and Expo, Des Moines, IA
Sep. 14	Festival of Color (features many native plants and grasses), Ithaca, NE
Sep. 15-20	Seventh National Bioenergy Conference, Nashville, TN
Sep. 16-17	34th Grass Breeders Work Planning Conference, Griffin, GA
Sep. 22	Pasture Walk, Audubon, IA

Oct. 1-6	3rd Annual Conference of the Wildlife Society, Cincinnati, OH
Oct. 2-5	Western History Association Annual Conference: Grasslands and Heartlands, Lincoln, NE
Oct. 21-24	New Zealand Grassland Association, Oamaru, North Otago, NZ
Nov. 3-8	American Society of Agronomy Annual Meeting, Indianapolis, IN
Nov. 6-8	Holistic Resource Mangement introductory course, Thedford, NE
Dec. 8-11	58th Midwest Fish and Wildlife Conference, Omaha, NE
Dec. 9-10	National Alfalfa Symposium, San Diego, CA
1997	
July 8-12	Private Grazing Lands in the 21st Century: Integrating Pastures, Environment, & People, Logan Utah

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